

Original Article

The pharmacological effects of topical ginseng root and leaf extracts (*Panax ginseng*) on the intraocular pressure of experimental Rabbits

Canice C. Asonye^{*1}, Ignatuis N. Amabo¹, Godwin C. Agu², Mac-prince C. Chimaroke³ and Godwill A. Engwa⁴

¹Department of Optometry, Faculty of Life Sciences, University of Benin, P.M.B 1154, Benin City, Nigeria

²Department of Optometry, Faculty of Health Sciences, Imo State University, Owerri, Nigeria

³Department of Optometry, Faculty of Health Sciences, Madonna University, Elele, Nigeria

⁴Department of Chemical Sciences, Faculty of Natural and Applied Sciences, Godfrey Okoye University, P.M.B. 01014 Thinkers Corner, Enugu Nigeria

*Corresponding Author

Canice C. Asonye
Department of Optometry,
Faculty of Life Sciences,
University of Benin, P.M.B 1154,
Benin City, Nigeria
E-mail: caniceasonye@yahoo.com

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Abstract

This study investigated the effect of *Panax ginseng* on the intraocular pressure of rabbit eye. Methanolic extracts of the root and stem of *Panax ginseng* (5mg/ml) were topically administered twice daily for five days to rabbit's eyes with increased intraocular pressure (IOP) induced with 1% atropine. The IOP lowering activity of topically administered *Panax ginseng* root and stem extracts of induced IOP of rabbits eye was evaluated using the KOWA applanation tonometer. The root extracts (5mg/ml) showed a reduction of IOP back to base within 5 days compared to the control ($p < 0.05$). The stem extract (5mg/ml) was so toxic that it caused severe inflammation, which led to multiple and purulent infections in the rabbit eyes. The data obtained suggest that the root extract administered topically possesses IOP lowering effects which may be mediated through the dilation of ciliary vessels in the ciliary body and antioxidant activities.

1. Introduction

Ginseng is referred to any of the eleven species of slow-growing, short, perennial plant with fresh roots of the *Araliaceae* botanical family and the genus of *Panax*. It grows naturally on the slopes of ravine and well drained mountainous hardwood forest. It bears five compound leaves on a single stalk at maturity and grows between 7 to 21 inches in height when wild. Its roots which is the main medicinal part used, is the most widely used medicinal plant component of the orient [1, 2]. According to the Oxford Dictionary online [3], the English word ginseng derives from the Chinese term "rénsēn" in which "rén" means "man" and "shēn" means "a kind of herb"; this refers to the root's characteristic forked shape, which resembles the leg of a man.

The African variety of *Panax ginseng* thrives in the mountainous regions of West, Central and East Africa. Both *Panax quinquefolius* and *Panax ginseng* roots are used as adaptogens, aphrodisiac, nourishing stimulants and in the treatment of type II diabetes as well as in sexual dysfunction in man [4,5,6]. So many studies have shown medicinal plants to have an IOP lowering effect of rabbit's eye but little is known on the effect of ginseng, hence the purpose of the study.

2. Materials and Methods

2.1 Plant material

Fresh roots and leaves of *Panax ginseng* were obtained from the botanical garden of Bamenda, Mezam division, North West Region, Cameroon and flown to Nigeria same day. Botanical authentication was

performed by Mr. Henry Adewale Akinnibosun of the Department of Plant Biology and Biotechnology, University of Benin, Benin City, Edo State, Nigeria.

2.2 Extract preparation

Freshly harvested roots and leaves of *Panax ginseng* were obtained and the leaves were destalked while the roots were selectively separated. The leaves and roots (leaf: 100g and root: 100g) of *Panax ginseng* were rinsed, cut and dried at room temperature in the drying room of the Department of Plant Biology and Biotechnology, University of Benin, Edo state, Nigeria. When crisp-dry, each type of the extracts (leaves and roots) was thoroughly ground to powder form. Both the leaves and roots were packed in the Soxhlet apparatus and 500mls of absolute methanol (Analytical grade) was used as the organic solvent for hot extraction. After the extraction, a fine smelling brownish solution of the roots was collected while a greenish solution with pungent smell was obtained from the stem.

The mixtures were filtered with fine filter papers (Sigma-Aldrich Inc, USA) while the methanol was allowed to evaporate. Each of the dried extracts (Yield = 15%) were used to prepare ophthalmic solutions in a concentration of 5.0mg/ml of distilled water [7,8]. The preparation of the eye drops from the extracts was supervised in the Department of Pharmaceutics, University of Benin City, Edo state, Nigeria. The prepared ophthalmic solutions were instilled into the rabbit's eye with sterile eye droppers.

2.3 Animals

Healthy adult New Zealand rabbits ($3.0 \pm 0.3\text{kg}$) of both sexes were acquired from the Animal Centre of Ambrose Alli University,

Ekpoma, Edo State, Nigeria. These animals were kept under standard laboratory conditions (12 hours of light and dark cycles). They were fed with standard pelletized chow (Bendel Feeds Plc, Ewu, Edo State, Nigeria) and clean water *ad libitum*. The animals were handled according to the regulatory guidelines for use of laboratory animals as stipulated by the University of Benin Animal Care and Use Committee with reference to the United State of America Animal Welfare Act[9].

2.4 Drugs and reagents

Methanol (analytical grade); methylated spirit; cotton wool; distilled water were all acquired from Sigma-Aldrich Inc, USA; Atropine 1% (Alcon Couvreur, Belgium); Fluorescein strips (Chauvin Pharmaceuticals, India); KOWA applanation tonometer (Handheld); HA2 series (KOWA Coy Ltd, Japan); Primax anaesthetic eye drop (Ashford Pharmaceuticals, UK).

2.5 Experimental

The New Zealand rabbits were all given the necessary pre experimental handling for adaptation before being randomly distributed into three groups of 4-6 animals (A, B and C). Atropine was instilled topically into rabbits eye for the treatment groups (A and B), while normal saline was instilled for 5days to induce an increase in the IOP of the rabbits eye. After this 5days, group A rabbits were topical administered 1.0ml ginseng root ophthalmic solution, group B rabbits were topical administered 1.0ml ginseng leaf ophthalmic solution while group C rabbits (the control) were topical administered normal saline into the eyes twice daily for 5days.

2.6 Measurement of IOP

Intraocular Pressure (IOP) was recorded only in the Right eye (RE or OD) of all the experimental animals during the experiment. The KOWA handheld applanation tonometer was used in the measurement of IOP of the experimental animals. Before IOP readings were obtained, the primax ophthalmic solution was instilled into the rabbit's eyes five minutes later and a strip of Fluorescein was inserted in the same eyes. The KOWA tonometer was prepared accordingly for the IOP measurement^[10]. The IOP was measured daily throughout the experiment for the baseline IOP on day zero before atropine was administered, for the 5 days when atropine was administered and the next 5days when the ginseng extract was administered.

2.7 Statistical analysis

All the results were expressed as mean \pm SEM. Statistical analysis was done using the one way analysis of variance (ANOVA) for determination of the differences among the groups. These result were suggested to be significant when $p < 0.05$.

3. Results

Measurement of the baseline IOP in the right eye of the rabbits was similar in all the three groups (Figure 1). After Induction of atropine, IOP increased up to 18.00 ± 0.30 mmHg in the right eyes of group B rabbits. Also, group A rabbits had an increase exceeding 16.00 ± 0.20 mmHg of IOP while group C which is the control hovered between 10.00 and 11.00mmHg of IOP (Figure 2). After administration of ginseng extract, there was significant reduction ($P < 0.05$) of IOP in group A animals which received the root extract below the range for the control (Figure 3). There was no IOP reading for group B because of the toxic effects of the stem extracts which resulted in corneal edema, purulent infections and severe inflammation of the corneconjunctiva (Table 1). The toxic component of the leaf extract is yet to be identified.

4. Discussion

The actual cause of increased IOP in Primary Open Angle Glaucoma (POAG) and glaucoma is increase in the flow resistance at the trabecular meshwork^[11,12]. In glaucoma patients, the meshwork becomes increasingly laden with substances that impede aqueous humour drainage. Specifically, POAG which is the major cause of blindness among

all types of glaucoma usually presents without anterior angle chamber changes that can be noticed with the normal instruments. The only probable change is increase in IOP. Hence, the enthusiasm to find means of reduction of IOP first. Again, glaucoma is the second largest cause of blindness worldwide.

Atropine is a mydriatic and cycloplegic. It is contraindicated in angle closure glaucoma. Therefore, it was administered to enhance angle closure by anatomically inducing shallow anterior chambers making it narrow (dilation of pupil) and tightening the trabecular meshwork, thereby decreasing outflow and subsequently increasing IOP.

Ginseng is grown in different parts of the world hence the eleven species available worldwide. It is the most popular herbal product in the ginseng belt of Asia. Of particular interest to us is the African ginseng which is grown abundantly in the central African, the Sub-Saharan region especially Cameroon (Bamenda) and Nigeria (Plateau and Taraba States).

A very common characteristic of Ginseng is its proven capability in restoration of vitality to the body probably by the vast antioxidants contained in the roots[13,14]. Again there is the ancient belief that ginseng clears the eyes thereby improving vision. This is one of the reasons why ophthalmic drops had been prepared so as to investigate its medicinal activity in the eye directly. Both the roots and stems extracts were used. From the result, the effects of ginseng leaf extract was found to be extremely toxic to the external adnexa (Table 1) viz group B. However, the root extract (group A) was found to be of profound significance in the reduction of atropine induced increase in IOP. The leaf extract rather induced conjunctival hyperaemia, severe photophobia, corneal edema, profuse lacrimation and irritation which also were followed a few days later with purulent discharges. The roots not only reduced induced increase in IOP, it as the ancient traditional medicine practitioners emphasized, made the eyes also clearer. Most works done on the pharmacological effects of ginseng were mostly based on the vascular system. Ginseng has been shown to improve blood flow which is strongly indicated in the outflow of the aqueous humour and a probable mechanism in reduction of IOP by enhancing the flow rate or clearance of obstructions in the trabecular meshwork.

More so, the root extracts had sweet smell with oily consistency which would be good for ointment production as ointment have prolonged dosage delivering advantages.

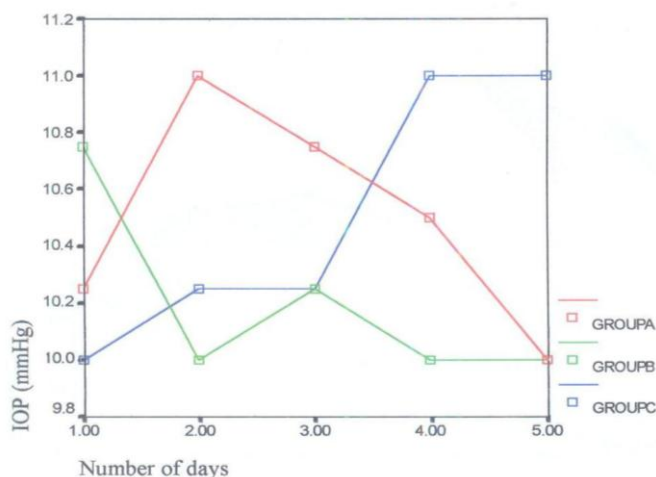


Figure 1: Changes in intra-ocular pressures of the rabbits right eyes prior to treatment

Legend: Group A and B; Experimental groups, Group C; Control

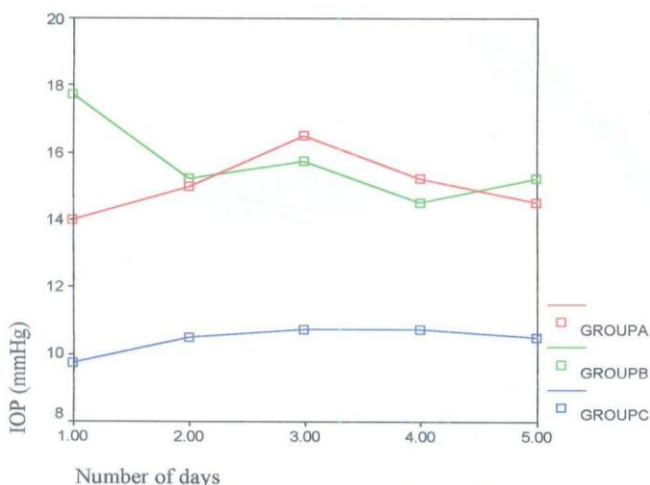


Figure 2: Changes in Atropine induced intra-ocular pressures of the right eyes of treated animals

Legend: Group A and B; Experimental groups, Group C; Control

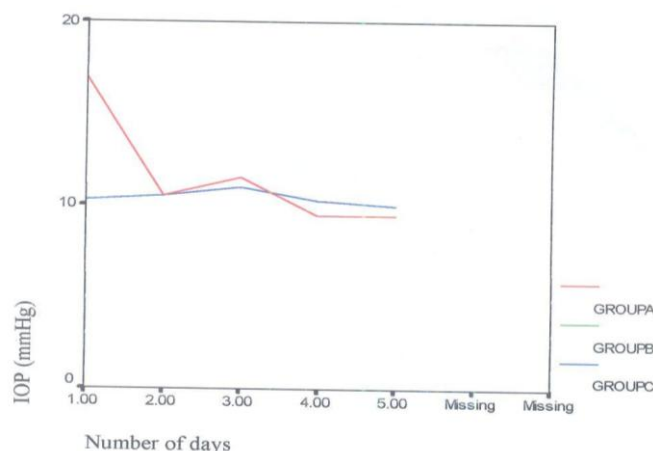


Figure 3: Changes in intraocular pressure of the right eye following treatment with ginseng extract

Legend: Group A; root extract, group B; stem extract and group C: control

Table 1: Observations of the external adnexia of the eye during treatment with root and leaf extract

Parameters	Group A Experimental	Group B Experimental	Group C Control
Eye lid	Normal	Swollen	Normal
Conjunctiva	Normal	Chemosis, Hyperaemia	Normal
Lacrimation	Absent	Present	Absent
Cornea	Normal	Hazy	Normal
Photophobia	Absent	Present	Absent
Discharges	Absent	Present	Absent
Edema	Absent	Present	Absent
Blepharospasm	Absent	Present	Absent
Pupil	Dilated	Dilated	Normal

5. Conclusion

Ginseng root extract has an IOP lowering effect on the eye. Ginseng is a plant of great medicinal value and needs to be further evaluated to understand its role in reducing IOP of the eye. This will indeed vindicate the ancient Africans who relied solely on traditional medicine using medicinal plant.

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Conflict of interest

The authors declare that there is no conflict of interest associated with this work.

Contribution of authors

We declare that this work was done by the authors named in the article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors

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